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2007
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OTS: 60-31,684

MAIN FILE

JPRS: 3721

19 August 1960

THE BOND BETWEEN NATURAL SCIENCE AND PHILOSOPHY

- USSR -

DTIC QUALITY INSPECTED 2

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DISTRIBUTION STATEMENT A

Approved for public release;
Distribution Unlimited

19980108 143

Distributed by:

OFFICE OF TECHNICAL SERVICES
U. S. DEPARTMENT OF COMMERCE
WASHINGTON 25, D.C.

Price: \$0.75

U. S. JOINT PUBLICATIONS RESEARCH SERVICE
205 EAST 42nd STREET, SUITE 300
NEW YORK 17, N. Y.

FOREWORD

This publication was prepared under contract by the UNITED STATES JOINT PUBLICATIONS RESEARCH SERVICE, a federal government organization established to service the translation and research needs of the various government departments.

JPRS: 3721

CSO: 3966-D

THE BOND BETWEEN NATURAL SCIENCE AND PHILOSOPHY

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[Following is a translation of an editorial by unknown author in Voprosy Filosofii (Problems of Philosophy), Moscow, No 3, 1960, pages 13-27]

The Twenty-First Congress of the CPSU [Communist Party of the Soviet Union] has set enormous tasks for Soviet scientists. Soviet science should make a significant contribution to the realization of the great plans for building communism: in the development of industry, agriculture, and to the general treasurehouse of the spiritual riches of mankind. For this purpose the Party has outlined a comprehensive program to assist Soviet science. As the resolutions of the Congress emphasized: "...the necessary conditions will be established in the forthcoming Seven-Year Period for the still more rapid development of all branches of science and the conduct of important theoretical studies and the realization of new and great scientific discoveries. An extensive program of scientific research projects which will concentrate scientific manpower and resources on the most important investigations of theoretical and practical significance has been outlined for this purpose."

The fruitful and healthy development of science requires not only being supplied with the material means -- laboratories, experimental apparatus, measuring instruments, et cetera, but also being armed with ideals which will guide the minds of scientists along the correct path and which will make it possible for them to approach the object of study with the methods that are most adequate for delving into its internal nature so that its essential nature will be discovered more thoroughly and comprehensively. Marxist philosophy will play an exceedingly great part in this "armament with ideas". In considering the further development of science, Soviet scientists posed a wide circle of philosophical problems of natural science for special discussion on the eve of the Party Congress. The All-Union Conference on Philosophical Problems of Natural Science which was convened by the Academy of Sciences, USSR and the Ministry of Higher Education, USSR met the urgent need. It has accomplished a significant work.

* * *

What were the principal results of the conference?

First of all, the conference demonstrated the presence of a very great interest on the part of Soviet scientists, naturalists, and philosophers in the problems of natural science. About 600 scientists of different specialties who had played a creative role in the development of science, many of whom had won acclaim for outstanding scientific discoveries, took part in the work of the conference. The high level of the conference is indicated by the fact that its participants included almost 100 academicians and corresponding members of the Academy of Sciences, USSR and the academies of sciences of the union republics. Those who wished to take part in the work of the conference were so numerous that the number of participants could have been increased several times if serious organizational difficulties had not arisen.

It is characteristic that after the work of the conference was completed, many scientific research institutes and higher educational establishments wished to become familiar with the results of the conference in more detail and invited persons who had participated directly in the conference to give reports. Thus, the conference not only reflected the fact that a significant number of scientists have a deep interest in the philosophical problems of natural science, but also served as a means for the further expansion of the circle of scientific workers who appreciate the real importance of these problems.

The great interest shown by the scientific community in philosophical problems of natural science provides evidence of the improvement of the ideological and theoretical level of studies in the field of natural science and philosophy. Wide circles of naturalists are becoming ever more convinced that work in a specialized field can become more successful if the scientist approaches the analysis of the problem he is investigating with a broad philosophical viewpoint. Philosophers explain more thoroughly that work in their own field should rest on those achievements of human reason which have been won in the field of modern natural history. This makes it possible to eliminate empiricism in natural science studies, to overcome the narrowness of view which is frequently characteristic of the scientist who has concentrated his attention on one special problem; this stimulates the introduction of problems of broad theoretical character and facilitates the better understanding of the connections between different sections of natural science, thus increasing their mutual support of one another. This helps to liquidate abstractness and sketchiness in philosophical works and to enrich their content with the most valuable factual material which can serve as the basis for posing completely new philosophical problems and further advances in the development of philosophical science.

The work of the conference showed that Soviet scientists are wholly unanimous in understanding what can serve, that is really serve, as the philosophical and theoretical basis of modern natural science. Dialectical materialism is such an ideological and theoretical basis of natural science. All participants in the conference started from this point. Starting from this viewpoint and from these positions, they attempted to analyze the scientific problems on the agenda. The speakers and those who participated in the discussions showed with a wealth of factual material that modern natural science brilliantly confirms all the basic propositions of dialectic materialism, which evidences its great perceptive power and its enormous heuristic significance. Those who spoke endeavored to apply the basic ideas of dialectic materialism to the study of the most important problems of natural science which are now arising and which are still to be solved.

As emphasized in the resolutions of the Twenty-First Congress of the CPSU, Marxism-Leninism constitutes the unchallenged supreme ideology of Soviet society. This triumph of Marxist-Leninist ideology in the sphere of the philosophical bases of Soviet science is expressed in the unchallenged supremacy of the ideas of dialectic materialism. This was demonstrated again at the conference.

The enemies of Marxism-Leninism try to explain this undoubted fact by stating that Soviet people, including even Soviet scientists, are "bound" by somebody to these teachings, counter to their will. How ridiculous! Marxism arose more than a hundred years ago in a society which hurled all its strength in a struggle against it. This society not only did not "bind" anybody to Marxian teachings, but did everything to suppress them and subjected its adherents to oppression. But, in the meantime, its adherents grew steadily in numbers. The Russian revolutionaries did not multiply in numbers because Marxism promised them any rewards. On the contrary, the fierce Tsarist Okhrana dealt with Marxists with particular severity.

The great Lenin developed Marx' teachings still further. He connected it with the conditions and problems of a new period in the development of human society. The number of adherents to the teachings of Marxism-Leninism began to increase still more rapidly even though the honor of belonging to the Marxists under the conditions of the capitalist order frequently meant payment with one's blood and even life. This was true not only in Russia, but also in other bourgeois states. Can anybody wonder, therefore, that the camp of the adherents of Marxism-Leninism has grown to the extent we see now, in which the shoots planted in the October Revolution have come forth in such abundance in our country and in which it has become possible to undertake the creation of a new social structure in a number of other countries?

Where, then, is the strength of Marxism-Leninism? In its truth! Nothing in the world can immortalize a lie. And there simply is no force that can stop truth. It inevitably finds its way and wins the hearts and minds of people. We see this in the example of Marxism-Leninism.

Dialectic materialism does not need to "bind" the scientist. It is not something foreign to science which can be joined with science by means of some gross external force that is inimical to the essence of scientific knowledge. V. I. Lenin showed the genuine bond between natural science and dialectical materialism fifty years ago in his book Materializm i empiriokrititsizm /Materialism and Empiriocriticism/. He illustrated this vividly by using physics, which came into its own after the great revolution like all natural science, as an example. Lenin stated that modern physics had given birth to dialectical materialism. In other words, dialectical materialism is the true child of natural science, the fruit of all scientific knowledge, and their fates are bound together. The birth of dialectical materialism, like science, was achieved through suffering, just as the Copernican system, the teachings of evolution, the kinetic theory, and other great discoveries of science were achieved through suffering, only the victims of class coercion were incomparably greater in number here.

The number of convinced adherents to dialectical materialism among the naturalists of the world is growing steadily. For example, how many have made a fuss about positivism, which has presumptuously cast itself in the role of the "sole" and the "genuine" philosophy of natural science. It has even included not a few well-known scientists in its ranks. Now, however, the greatest figures in natural science are leaving it, one after another, being impelled to this step solely by the impartial imperatives of the truth. These scientists are not simply rejecting the positions of positivism in silence, but are voicing convincing expressions of open disenchantment with this philosophy and their disagreement with it in respect to basic questions of world outlook. We know now that many bitter words have been spoken about positivism by such outstanding scientists as, for example, Louis de Broglie, Max Born, and, in recent times, Werner Heisenberg who have at some time in their activities renounced positivist views. They have strengthened that line of argument against idealism which was developed earlier by Paul Langevin, Max Planck, Ludwig Boltzmann, and others and which took the same course of criticism of positivism as that followed by dialectical materialism.

The movement of naturalists toward dialectical materialism is a movement toward truth. Therefore it is invincible.

The conference showed the greatness of the field of activity in the sphere of the philosophical problems of natural science, the variety of problems which stand before every research worker who wishes to contribute his bit to this department of modern science. These problems were elucidated in the papers, in the discussions, and in the resolutions of the conference. They touched upon quantum mechanics, the physics of "elementary" particles, cybernetics, mathematics, astronomy, biology, biochemistry, biophysics, genetics, physiology, the higher nervous activities, and other sciences. Much was said of problems that are to be solved, but there is no doubt that the further development of natural science, which is steadily forging ahead, will pose still more enticing and fundamental problems.

It is clear that the creative solution of the complex of these problems simply cannot be accomplished by any individual group of scientists, no matter how authoritative the scientific institution in which they work may be and no matter how talented and gifted they may be. Here the concerted efforts of all the figures of Soviet science are needed. This is why the conference raised the question of the necessity of extending the front of research on the philosophical problems of natural science in all the most important branches of natural science with such acuteness.

However, it is impossible to believe that these problems can be solved successfully when isolated from each other, within each separate branch of natural science, let us say, by quantum physicists or specialists in the theory of "elementary" particles, geometers or specialists in the theory of probability, physiology, genetics, etc. Here it is necessary to go beyond the limits of narrowly professional specialization and to secure the mutual assistance of scientists who belong to widely different branches of natural science. The philosophers of natural science and their creative collaboration is playing and must still play an especially important role.

When studying the problems connected, for example, with the theory of relativity, the physicist is faced with, in particular, such problems as that of the connection between space and time. This connection is so deep and vital that the opinion has been expressed to the effect that there is no space and time, as two individual, qualitatively unique forms of existence of matter, but there is one single form of existence -- some "space-time". Without predetermining the answer to this question, which requires incomparably deeper study than any undertaken up to this time, we should recognize that an exceedingly important role in the study of this problem will be played not only by the formulas and propositions of the theory of relativity, but also the general ideas of dialectic materialism on space and time, on the relationship of form and content, the absolute and the relative, essence and appearance. However, these ideas are not something given once and for all, completely finished. They themselves in turn cannot help but be developed and deepened on the basis of new data from natural science, in particular from the data of the theory of relativity. And it is the development, the deepening and concretization of the general ideas of space and time, of form and content, of essence and appearance that is the direct obligation of the philosophers. Thus, the thorough development of the problem of space and time in physics turns out to be indivisibly connected with its development in philosophy. Physics and philosophy should work together here, depending upon each other for support.

However, the study of the problem of space and time is not by any means the privilege of just the philosophers and the physicists. Natural scientists of other specialties, for example, biologists, can participate in it in a significant manner. The specifics of spatial forms and spatial relationships in the field of the bodies of living nature indicate a

dependence of the properties of space upon matter which goes beyond the framework of dependence upon just the physical characteristics of matter -- specific patterns of biological character also have a material effect in the formation of the properties of space in the field of living nature. By its very essence the problem of space and time, which is fundamental for natural science, has turned out to be a common problem for physicists, for mathematicians, for biologists, and for philosophers. At the same time, the latter cannot help but undertake the very difficult task of generalizing and synthesizing into a unified whole everything contributed by individual branches of natural science. In the meantime, without such a generalization, no synthesis of the results obtained within the frameworks of individual specialized sciences can be recognized as even relatively complete, for their deep sense can be revealed only in connection with that whole, of which they (of their own nature) are a part or aspect.

Here is still another problem which we would like to use as an example to illustrate the significance of collaboration by scientists of different specialties: to what extent, within what limits can the methods of one specialized science be used in studying an object which belongs wholly to the sphere of another science? This problem has become very important in modern natural science when the far-reaching differentiation of science into separate branches is accompanied by a process of intensive integration of the separate branches of knowledge -- the process of their intimate interpenetration. Let us say that a biologist makes use of the methods of modern physics, its experimental means and concepts with exceptional success in his research into living nature and obtains astounding data which reveal a hidden mechanism of the processes which are taking place. But where is the boundary, on the other side of which physical methods and concepts cease to be adequate for the essential nature of biological phenomena? And is there such a boundary, in general? Physical methods themselves are so delicate, so rapidly completed, and penetrate so deeply into the heart of matter that it seems there should be no limits to their applicability. Can other methods which are different from physical methods be fruitful in natural science? Are not nonphysical methods merely substitutes for scientific methods of investigation? These are not idle questions. They arise in the concrete work of the natural biologist and are actually tied in with its progress. A biologist will have to answer these questions irrespective of whether he likes to "philosophize" or not. In searching for answers to these questions, however, he cannot help but turn to the teachings of dialectical materialism concerning movement as a form of the existence of matter and concerning the qualitative uniqueness of different forms of movement. It is here that philosophy and the study of philosophy will come to his aid. On the other hand, philosophers who are occupied with the generalization of data from natural science are faced with the necessity of proceeding further along the path of developing the general ideas of dialectical materialism concerning the forms of movement of matter, even

though these ideas have been confirmed brilliantly by the entire development of natural science, but still need further perfecting, like all scientific knowledge. Thus, problems which have been posed by the conduct of concrete research in one branch of natural science inevitably grow into a general philosophical problem which is of fundamental importance in all branches of natural science and in scientific knowledge as a whole. Such a problem can be solved in a really deep and comprehensive manner only through uniting the efforts of naturalists and philosophers.

Modern physics is moving forward with amazing impetuosity. The need for critical reexamination of older concepts and earlier theories arises frequently. This leads to definite breaks with deeply rooted views and the appearance of new physical theories which differ radically from the old ones. It is well known what a sharp break was involved in the transition from classical mechanics to the theory of relativity and from pre-quantum physics to quantum theory. This was followed by repeated revisions of concepts in a number of other departments of physical science, even though smaller in depth and scope than the changes mentioned above and not attracting such general attention as those changes, but still very definitely affecting the fate of physics. Now physics, which is taking a new step into the depths of matter and penetrating into the structure of the "elementary" particles, is faced with the necessity of a new fundamental and far-reaching revision of its concepts and theories which promises to change a number of its fundamental ideas. We are encountering analogous situations in other branches of natural science, too.

Scientists who are pondering the fate of their own science and attempting to make their creative contribution to it cannot help but raise the question as to whether all these revisions are chance. Might not these revisions be connected with some organically incomplete former ideas from which the science is freed sooner or later, then no more such perturbations would ever again disrupt the absolutely "smooth" course of its development on the basis of ideas and theories established once and for all? But, perhaps these breaks and revisions of concepts and theories belong to an inevitable, general law of development of scientific knowledge which acts throughout its entire existence?

In this case, what is the fate of the old views and should there be a connection between the former and the new theories? What is the concrete form of this connection?

These are not idle questions arising out of simple curiosity and having no relationship with the course and the nature of the research work done by the scientist. On the contrary, they arise out of the very practice of the scientific research done by naturalists and precise and clear answers to them must be found, for they will determine how the scientist will act when the need for revising scientific theories arises again. Physical science answered those questions that were applicable to physics with the actual course of its development. This answer was

expressed in the existence of the wide recognition and propagation of the principle of correspondence which establishes a regular, sequential interrelationship between the old and the new physical theories. But in order to reveal the deep thought of this connection between theories, it is necessary to turn to dialectical materialism, to the teachings developed in it concerning the objective, the relative, and the absolute truth, and of the relationship of the abstract and the concrete in scientific knowledge. Here again success will be achieved only on the basis of the collaboration of philosophers and naturalists.

Study of the specific patterns of development of natural science, scientific theories and concepts is one of the vital tasks in the field of the philosophical problems of natural science. Its solution is important for all branches of research work. However, the laws and concepts of physics, the formulas of mathematics, the laws and concepts of chemistry, the ideas of biology, etc are inadequate here. The equipment which the naturalist uses in his laboratory is of no help at all in this sphere of knowledge; the experimental method in general is helpless here. This sphere is governed by its own special laws: here the research worker is compelled to turn to concepts which he never dealt with in physics, or in mathematics, or in chemistry, or in biology, or in any of the other natural sciences. He needs the help of philosophy. Only with its support can reliable scientific results be obtained.

The very same thing can be shown for any of the great problems of modern natural science.

One of the most important results of the conference was the realization by wider circles of naturalists than before of the urgent necessity for the close collaboration of naturalists and philosophers -- their close unification for creative work. The resolutions of the conference point out a number of measures of organizational character which have the purpose of developing this collaboration. There is no doubt that life itself will reveal new ways and means in the future for realizing the creative collaboration of philosophers and natural scientists.

As long ago as 1922, V. I. Lenin advanced and justified the splendid idea of an association of Marxist philosophers and the workers of modern natural science in his work O znachenii voinstvuyushchego materializma /On the Significance of Militant Materialism/. He saw in this association a pledge of the successful development of Marxist philosophy and of natural science. Since this time much has been done in our country toward the realization of this idea of Lenin's. The association of philosophers and natural scientists was founded and gradually grew stronger, which had a favorable effect on the fate of all Soviet science, whose blossoming has now become obvious to the entire world. Now a new significant contribution has been made toward widening and strengthening this association. It is this which constitutes the basic significance and the basic results of this All-Union Conference on the Philosophical Problems of Natural Science.

The participants in the Conference were wholly unanimous in recognizing that dialectical materialism is the naturally true philosophy of natural science, that it constitutes a theoretical and ideological foundation for natural science, and that it corresponds harmoniously with the spirit and nature of all the great achievements of science. That is how matters stand, irrespective of the fact that dialectical materialism still has many opponents who attempt not only to contradict this, but also to refute it in general as the scientific philosophical system.

But even though these attempts remain and will inevitably remain unsuccessful, it is the duty of Soviet scientists, philosophers, and naturalists decisively to repulse these attempts. The conference summoned all scientists to still more active struggle against idealism and metaphysics and their manifestations in natural science.

The struggle with idealism and metaphysics can never be regarded as something which lies exclusively in the sphere of the special, professional interests of the philosophers, and only there. No! It affects the basic interests of all natural science and those of all its branches. As V. I. Lenin emphasized in his work Materialism i empiriokrititsizm /Materialism and Empiriocriticism/, natural science is not by any means neutral in the struggle between materialism and idealism. The thesis of the "neutrality" of science in the struggle between materialism and idealism is the favorite idea of E. Mach and all positivists in general.

The history of science shows that positivism, in the words of those who praise "positive science" most loudly, seems at first glance to be concerned only with freeing science from all restrictions, from all kinds of "metaphysics", all kinds of "metaphysical limitations", from all "pressure" and "coercion" from outside, but it is actually attempting to force natural science into a Procrustean bed of dogmatic schemes which will have a lethal effect on the development of natural science. Although natural science has overthrown these schemes over and over again, positivism has attempted again and again with a persistence worthy of better application to use these schemes to bind natural science. If somebody were to try to compile a list of even a small fraction of those theoretical pseudo-inventions which positivism has "given" to natural science and which natural science sooner or later refuted, then he would have a list of such convincing size that it would of itself have the force of irrefutable proof against this philosophy. Some items from such a list can be mentioned here.

At one time the founder of positivism triumphantly proclaimed that science would never be permitted to find out the chemical composition of the sun. This prophesy did not last long. The establishment of spectral analysis ended it once for all, almost before the printer's ink had dried in those books in which it was first encountered by natural scientists. How the adherents of Machist philosophy mocked and laughed at the atom-molecular theory of matter! They categorically claimed that atoms were nothing more than phantoms out of the diseased imaginations of certain scientists, harmful chimeras; and loudly demanded that natural scientists reject them once and for all. However,

natural science did not put an end to atoms, but to positivist atomistic conceptions. Then the time came to recognize atoms. The positivists "recognized" them, but only as useful "logical constructions". However, even those natural scientists who were won over at first by this recognition of the importance of atomistic views, which had the appearance of the agreement of positivism with the atomistic view, were able to perceive the true nature of this "recognition" later and separated from the positivists. Atoms are not "logical constructions" but real particles which move and which have their own objective laws. Such were the results of the dispute between the physicists and the positivists over this problem -- results which did not bring any glory to positivism.

This is not a particular question, and the divergence in regard to it is not of a particular character. Its solution determines how one is to understand in general the fundamental task of science: should it merely put in order and classify our perceptions by means of logical constructions or should it, on the contrary, make use of those perceptions to penetrate into the depths of the objective material world which exists outside of and independent of these perceptions and to learn its nature. Here the yawning precipice between positivism and natural science which forever divides the two cannot be hidden from those who wish to think about the foundations of science.

One of the dogmas used by the adherents of positivism to bind natural science is the categorical directive formulated by those adherents: "Science should make use only of basically observable quantities." This sounds very "realistic" and seems to be directed exclusively against the fruitless and unfounded speculations of those who have ceased to stand on the firm ground of experiment. But, in fact, this serves to hide the harsh scheme which would place heavy fetters on the creative activity of the scientists. The thing is, what is meant by "basically observable". From the standpoint of dialectical materialism, everything that exists in the environment which surrounds us is definitely "basically observable" regardless of whether or not it is known to us now, whether or not it is reflected in the theories that exist now. For positivism, however, only that is "basically observable" which has been factually discovered through experiment on the present level of development of science or which can be interpreted as experimentally discoverable from the viewpoint of presently existing theories. Dialectical materialism justifies the boundlessness of perception and opens unbounded possibilities and perspectives before scientific knowledge. Positivism, on the other hand, hampers the creative initiative of the scientist, stopping him at every step with the stern warning: "Stop! Do not go farther -- this is basically unobservable! Cast it aside!..."

Happily for mankind, natural science has never heeded such prohibitions, and this is precisely why it has advanced farther and farther. It has always been guided by the "sinful" (from the viewpoint of positivism) idea of ceaselessly going beyond the framework of that which is "basically unobservable" for the contemporary level of experiment and theory. It is difficult even to imagine what would be the present state

of the atomist if natural scientists, who had no direct proofs of the existence of atoms for a long time, had refused to recognize atoms and had abandoned the search for such proofs. Without having recognized atoms as being "basically observable", it would be all the more impossible to classify electrons in this category of things. Matters would be still worse in the case of those material objects which, as one may think today, are the elements of the structure of such particles as protons, neutrons, electrons, etc. What would be left for theoretical physicists to do if they were sworn to observe the legacies of positivism and had not, for this reason, introduced the so-called "psi function" into quantum mechanics? Even if we were to stretch a point, it would be impossible to include it among the "basically observable" quantities as those quantities are understood by positivists; but it is impossible to imagine modern physics without the "psi function".

Positivist philosophy deprives natural science theories of creative and heuristic significance. It places them in a very difficult position. They are actually forbidden to play an active role -- they must follow passively behind experiment and merely summarize data collected through experiment. They are not permitted to lead the thoughts of the scientist into the sphere of the entirely unknown since they are fettered to the narrow, already-known chain of the "basically observable". Thus, positivism always attempts to make the aggregate of accessible knowledge into a heavy burden which deprives the mind of man of the possibility of rising upward. In contrast to this, dialectical materialism sees in the store of knowledge already won by science as a springboard for new flights of science.

Still other schools of idealism play a role like that of positivism. This is why natural scientists cannot help but regard the struggle with all these schools as involving his vital interests and cannot help but be with the Marxist philosophers. This is why the conference emphasized the need for the all-out development of this struggle with idealism and metaphysics which is being conducted in the interests of both philosophy and natural science.

In order that criticism of idealism may achieve success and bear desirable fruit, it must be precise, aimed at and reaching the essence of the natural science problem under discussion. The matter does not consist merely in citing various statements of the scientist under criticism and giving evidence of the erroneousness of his stand on general philosophical questions, thereby establishing that this scientist is an adherent of a definite school of idealism. The effectiveness of such criticism is small. It accomplishes little, particularly in those cases in which a foreign scientist is subjected to criticism who is not aware of all the real dangers to which he is doomed by an idealistic system of views. Frequently such a scientist even agrees willingly with having his position called idealistic as he sees nothing mistaken or shameful in it.

The main thing in the criticism of idealism in the field of natural science is to explain that it is precisely in a given problem that it /idealism/ can serve as a cause or basis for such great material error, and to what kinds of consequences for natural science this philosophical error is leading or could lead. Such criticism of idealism is difficult, but it does give markedly greater results. It eliminates the difficulties which arise in the way of development of theoretical natural science. It makes the danger of idealism felt in a concrete manner, so to speak, since it reveals how this danger directly affects the course of scientific work. Such criticism will enable more and more new scientists among the naturalists of the capitalist nations to leave idealism; for although many of them have begun to view the ideological principles of idealism critically, they have not as yet rejected it entirely.

However, far from all the scientists who have a good understanding of the erroneousness of the general propositions of idealism have a correct idea of the complexity of the struggle with idealism and with its manifestations in natural science. It seems to some that inasmuch as science deals with facts and "not idealistic or materialistic facts" that this of itself guarantees us from the penetration of idealism into natural science. Why, then, should we fear idealism if "idealism never occurs in nature?" But, we are speaking not only of nature itself, but also of its reflections in human consciousness. Moreover, this latter is not a simple mirror reflection, but is a complex and contradictory process which includes the possibility of flight from reality, so that which does not exist at all in nature may appear. You know, there is no God in nature, but the majority of people believe in Him, and this has a very material effect on their behavior in real life. Idealistic philosophy, which exists only in the minds of people, does affect their activities, particularly their scientific activities, in a manner analogous to the foregoing.

It is true that science deals with facts. However, facts enter science only in their generalized form and only in close connection with theoretical views. There cannot be "pure" facts, facts "of themselves" without any theoretical interpretation in modern science and which go far into the depths of the hidden nature of things. What, for example, is the "fact" of the birth of pairs of particles -- the electron and positron? So far as the physicist's direct senses are concerned, this "fact" is a bit of photographic paper on which two curved lines originate at one point, curves which are bent in opposite directions and which look like little chains of light dots which almost merge with each other. This is a "fact". But such a photograph alone is devoid of any sort of scientific value. It acquires the meaning of a scientific fact if all the main details represented in the picture are connected theoretically with the conditions of its formation: with the presence, for example, of a magnetic field; with the magnitude of the effect of this field on material objects which possess electric charge; with the ability

of moving particles to ionize a gas; etc. Only in the presence of such considered theoretical interpretation does this "fact" actually become a fact; that is, enters physical science. Otherwise it is either rejected as "without sense" or it will have to wait, remaining beyond the limits of science and awaiting theoretical study. Only after it is developed does it enter the fund of the acquisitions of science.

When the theoretical interpretation is being developed, for the most part concerning the mutual connections of the aspects of different facts, the influence of idealism becomes possible, and it may enter scientific theory under the authority of the screen of "empirical data". As a rule, reliably obtained empirical data are never repudiated idealism. It "merely" gives them its own special interpretation, and it attempts to introduce them into science with this interpretation. Thus, idealistically distorted theories of natural science occur from time to time. One of the original variants of the theory of beta decay which was established in 1931 is an example of such theories. The "fact" consisted in that the energy of an electron emitted in beta decay could acquire a continuous series of values. The bare statement of this circumstance provided but little direct information as to the nature of beta decay. A theoretical interpretation of the empirical data was required - an interpretation which would connect the basic conditions under which the process took place. The main condition was the fact that the internal energy of the radioactive nuclei which emitted these electrons had only a series of discrete values. However, this had to be connected with another bond not perceptible to the senses. Then a theory appeared which stated that the values of the energy of the electrons emitted in beta decay were connected with the values of the internal energy of the nucleus in a purely statistical manner; that is, according to this theory beta decay proceeded in such a way as to violate the law of conservation and transformation of energy. The idea of the violation of the law of conservation of energy was represented as an "obvious fact". Thus, this theory claimed that it dealt only with "facts": a continuous spectrum of energy of electrons, a discrete spectrum of energy in the nuclei, etc -- and many believed this. Nevertheless, however, its essential nature turned out to be not in accordance with the nature of things -- to be idealistic. True, this theory lasted but a short time.

Soon a materialistic theory of beta decay was established which not only retained such a fundamental principle of materialistic philosophy as the law of the conservation and transformation of energy, but stemmed directly from it and still made use of the empirical data. This theory was confirmed in science.

We have examined one of the very simplest examples. But even in this case we see in what a complicated manner elements of idealistic views can be interwoven with empirical data and how difficult it is at the outset to separate the first from the second and to eliminate them from science. Therefore, one is compelled to listen at times to claims alleging that attempts toward a critical examination of this or that

theory of natural science with the objective of eliminating elements of idealistic views from it are no more or less than "ignoring factual data" even though there is no question of ignoring genuinely factual data.

However, the history of natural science shows that there is an inevitable process of purging idealistic distortions out of natural science. Theories permeated with idealism fail and die out. Then it seems to somebody who sees only the finished result of this process, this "historical distillation", and forgets the long roundabout wanderings of scientific thought that the mere circumstance that "science deals with facts" guarantees natural science from the penetration of idealism. Science which seeks objective truth is materialistic by its very content and by its very nature. But, in moving along the path toward truth it passes through many errors; and idealism and metaphysics are responsible for the chief errors. Without criticism of idealism and metaphysics, natural science cannot be liberated from their rotten influence. Thus, it is understandable why the conference devoted so much attention to the problem of the struggle with idealism and metaphysics and why a number of the persons who participated in the discussions rightfully reproached some of the speakers on shortcomings in their criticism of manifestations of idealism in the problems they examined.

The distinguishing feature of the Conference was the fact that it had the character of a free, comradely, and businesslike discussion. It was entirely free of "directive" and "cut-and-dried" reports which would have been accepted as something previously established and not subject to discussion or criticism. On the contrary, all the reports were subjected to critical remarks which were quite sharp at times. Those who participated in the discussions not only engaged in disputes with those who gave reports, but also with each other.

The agenda of the Conference had only one formal paper on quantum mechanics. However, the viewpoint of V. A. Fok which was expressed in that paper was not received as the only possible viewpoint. The existence of still other viewpoints was stated at the Conference: one was connected with the work of D. I. Blokhintsev and others ("the theory of quantum ensembles") and the second with investigations made by the school of Louis de Broglie -- Vigier and D. Bohm (the so-called "casual interpretation of quantum mechanics"). Although just one paper was listed on the theory of relativity, the discussion brought out very important differences in viewpoints on its problems too. The debates were hot on the problem of the origin of life, on certain aspects of cybernetics, etc.

The participants in the conference who entered into disputes on these questions still came to no unified viewpoints. However, the conference did not and could not set as its objective some simultaneous act or "single gesture" which would exhaust and complete scientific discussion on these fundamental problems of contemporary natural science. It helped to bring out disagreements, permitted clear and precise formulations of the positions of the disputing sides, and provided material for

evaluating the significance of the arguments of the opponents and for revealing the weak and strong points in the views which were presented. Thus, even though the conference itself did not establish a "final point" for the debates, it did facilitate progress in the study of the problems presented there.

In general, however, it is far from possible to establish a "final point" at all times and at all places. Clarification of the truth in respect to one problem inevitably leads to the appearance of a new, unsolved problem in another, and this is accompanied by new disputes. This will always be the case as long as science exists.

The opponents of Marxist-Leninist philosophy endeavor to represent dialectical materialism as a stiff, dogmatic system of views which exclude the possibility of any divergences in special problems of science and which wholly "unifies" the thinking of the scientist, fettering the creative initiative of the research worker who is seeking new ways in knowledge of nature. The whole history of Soviet science refutes these fabrications. The creative discussions at the conference again showed their absurdity.

It is characteristic that many of those who are particularly inclined to reproach Marxist philosophers for "narrowness of views", "dogmatism", and "unification of thinking" actually turn out to be persons who have an especially intolerant attitude toward views which differ from their own. They become the champions of those one-sided conceptions and dogmas whose "tyrannical influence" (as expressed by L. de Broglie) has excessively restricted the creative possibilities of science over the last few decades. This was the situation, for example, in the field of quantum mechanics. Marxist philosophers who were struggling with idealism in quantum mechanics have repeatedly pointed out the possibility of developing several different points of view in this field of science, thus creating the conditions for creative competition. In contrast to this, a number of the leading professional physicists, adherents of the so-called "orthodox interpretation" of quantum mechanics were unusually harsh with those who disagreed with them, even though it was not, and is not now possible to consider proved that the creative possibilities of the viewpoints with which they quarreled were completely exhausted.

Dialectical materialism offers the scientist unlimited opportunities for research and does not hamper him in any way in the selection of methods and ways of studying the world which surrounds us. Of course, this does not mean that it [dialectical materialism] does not require the subordination of scientific thinking to certain laws. If this were the case, then science would cease to exist. On the contrary, dialectical materialism points out that a real need exists in scientific activity to take into account a number of the most general laws of development of nature, society, and

thinking. It formulates these laws which were first revealed by it in a precise and clear manner. These laws constitute the most adequate expression of the essential nature of all the achievements of scientific knowledge taken in their organic unity. They constitute the very essence of science and are not something which bind it from outside.

Nobody should be surprised to find after studying various concrete cases of the movement of macroscopic bodies that we have "conditioned" the course of our thinking to the laws of Newtonian mechanics and to Maxwell's laws of electrodynamics in the study of electromagnetic processes. To reproach a scientist or engineer because he follows those laws and subordinates himself to their bidding on the grounds that this subordination "fetters the initiative in thinking" means that one does not understand the essential nature of the perceptual activities of man. However, the most general laws of the development of nature, society, and thinking, which are contained in the teachings of dialectical materialism, play a similar role in all fields of science and they should be taken into account in the research activities of every scientist.

To see in such necessity for agreement of the creative activities of the scientist with the general laws of the development of nature, society, and thinking as something which "interferes" with his knowledge of nature, "fettering" his creative initiative, and "unifying" his thinking is just the same as regarding the law of the conservation of energy as an obstacle in the development of technology because it rejects the possibility of inventing any sort of perpetual motion; and it is just the same as seeing the multiplication table as something which hampers the development of initiative in the field of computation since it "unifies" the principles of all sorts of computation.

However, the creative application of the laws of dialectical materialism to each of the concrete fields of science is far from a simple matter due to the extremely general character of those laws. This application does not tolerate stencils or schemes and is itself a great perceptual problem. Therefore research workers who start from the very same premises of dialectical materialism can have differences of opinion as to how one can best apply its laws to a given problem. In the long run the truth will be found. But, even here it will be won through discussion and debate. Still, this path of discussion and debate is the most promising and fruitful.

There is nothing surprising in the presence of such divergence. The history of science contains many examples in which scientists differed very greatly in their opinions of how to apply certain laws equally well recognized by them to this or that branch of natural science. Such divergence of opinion still exists.

The Conference especially emphasized the importance of developing creative discussions. It pointed out the necessity for the regular convocation of conferences both on separate philosophical problems of natural science as well as on the entire complex of kindred problems. It is extremely important that these discussions should be carried on in an atmosphere of creative collaboration, in an atmosphere which makes possible the further strengthening and expansion of that association of natural scientists and philosophers which was formed in our country in accordance with the ideas of V. I. Lenin.

Strengthening and extending this association, natural scientists and philosophers should work in equal measure to develop the philosophical problems of natural science. This is not only the right but the duty of those and other persons. However, one may hear at times allegations to the effect that philosophical questions relating to this or that field of natural science can be studied only by natural scientists who are working in the given field of natural science. It is claimed that those who "do not work with their hands or their heads" directly in some department of natural science have not "created anything real" in it and cannot, do not have the right to judge the philosophical problems which arise in this field of knowledge.

There is nothing more incorrect than this viewpoint. When it is carried out consistently it turns out to be directed against the very nature of the association of philosophers and natural scientists.

The fact that a given scientist works in some experimental laboratory and creates "something real" (for example, designs computers, compiles cybernetic programs, or discovers new polymer substances) cannot constitute a guarantee of his success when he wishes to turn to the philosophical problems of natural science. This is merely a prerequisite of success, even though a very important prerequisite. Another, no less important prerequisite is a thorough knowledge of Marxist philosophy and the ability creatively to apply it to an unstudied sphere. Any naturalist can master the principles of dialectical materialism and learn the strict scientific application of its propositions if only he spends the necessary amount of work on this. But any creatively working philosopher can proceed in just the same manner to make a thorough study of the basic sum of knowledge in a given branch of natural science and can acquire the capacity for independent examination of the status and the problems of this branch of science. In both cases the natural scientist and the philosopher have to leave, to some extent, the bounds of their narrowly professional specialization and, by turning to investigation of the philosophical problems of natural science, they will come to meet each other. The degree of success each of them will win will depend exclusively on their

personal talents, their ability faithfully to orient themselves to the new set of problems, and on their industriousness. But the side from which they have approached the given set of problems is a matter of no importance at all.

This departure from either type of specialty is inevitable since the philosophical problems of natural science form a special field of knowledge -- a special field of scientific investigation. Both philosophers and natural scientists can work successfully in this field if theoretical interests attract their thoughts here. It may be that many of them will turn to this field only in connection with some individual problem or group of problems. Undoubtedly, however, there must also be research workers whose attention and efforts will be concentrated wholly on these philosophical problems of natural science. The interests of the cause require that such investigators become ever more numerous.

The fact that successful professional activity in a specialized field of natural science does not of itself ensure success in the study of the general theoretical, philosophical problems of science is shown by the examples of the botanist and zoologist Alfred Wallace and the physicist William Crookes. These men were very great natural scientists of the second half of the 19th Century, but as F. Engels pointed out, in spite of all their attachment to experiment, they fell victim to the wildest of all superstition -- spiritualism. This happened to them as soon as they attempted to go without proper theoretical philosophical training into a field in which purely empirical methods had served. W. Ostwald and A. Poincare who had made many very valuable special studies in physical chemistry, physics, and mathematics but who turned out to be very poor philosophers, as was proved by V. I. Lenin, are more recent examples. Finally, it is possible to mention the modern physicist P. Bridgman, who made a very significant contribution to the physics of high and super-high pressures but who suffered bitter misfortune in the sphere of the philosophical problems of natural science inasmuch as the "operationalism" established by him cannot be evaluated as anything but a philosophical delusion.

In contrast to this one can point out the example of such philosophers as K. Marx, F. Engels, and V. I. Lenin who worked in the field of the philosophical problems of natural science in an incomparably thorough and comprehensive manner, leaving a magnificent ideological heritage to the following generations of scientists.

The close collaboration of scientists of all specialties, philosophers, and naturalists is what will ensure success in the development of the philosophical problems of natural science. This collaboration must be strengthened and extended in all possible ways.

While speaking of the results of the conference, one must also mention some of its shortcomings.

In order to obtain better development of discussions on a number of problems under consideration, it would be well to have several papers on each of them, and not be limited to one paper on each of them. This would permit more objective debate by the disputing sides and better weighing of the advantages and shortcomings of their positions. The possibilities of entering the debates that would be presented to adherents of viewpoints different from those of the speakers would be significantly improved and the discussions would be more fruitful.

The philosophical aspects of special problems of natural science were very poorly developed in some of the papers. At times the description of the factual natural science material became self-sufficient.

Some of the papers were defective in that they had not devoted the proper amount of attention to the struggle with idealism in natural science. The importance of developing the struggle with idealism was emphasized in a number of speeches and also in the resolutions of the conference. However, it still remains a fact that some of the speakers did not place the proper value on the significance of criticism of idealistic views.

I believe that the agenda of the Conference should have provided for the reading of papers specially devoted to a critical analysis of the theoretical principles of those idealistic schools of thought which now claim a leading role in natural science and which still influence many natural scientists (logical positivism, operationalism, holism, etc). This would have permitted the participants in the conference to present more clearly the general picture of the philosophical struggle in natural science, the acuteness of which is frequently forgotten by some scientists who direct their attention only to the advance of science.

Unfortunately a number of great Soviet natural scientists did not take part in the work of the Conference. Doesn't this indicate the presence of surviving remnants of "philosophical indifference" among a certain part of the natural scientists? It is necessary to put an end to it as soon as possible in the interests of science.

The philosophy of dialectical materialism is a wholly consistent scientific, revolutionary philosophy. It is irreconcilable with any superstition, mysticism, metaphysics, idealism, and dogmatism. It inspires and guides the searching, daring thinking of scientists in learning the secrets of nature and the thinking of engineers in taming its forces in the service of man. This philosophy teaches one to combine theory with practice, to check theory against practice, and to enrich it with experience from life, sweeping to the side wretched, crawling empiricism and the barren scholasticism of "pure theory" remote from practice and from life,

and the diseased phantasy of idealism, mysticism, and religion. Therefore, there is nothing more natural and logical than the association of dialectical materialism and natural science. This association has now been expanded and strengthened, acquiring the form of a permanent, cooperative, and creative collaboration and mutual assistance of the philosophers and the natural scientists of our country. This is wholly logical in a country in which socialism has won completely and finally, which is advancing now with seven-league strides toward communism; in a country which has become the invincible citadel of all advanced world science and culture; which has placed all the achievements of science, technology, and culture at the service of the people and toiling mankind; which has opened a new, genuinely wonderful and magnificent epoch of the conquest of all the forces of nature for the benefit of man, an epoch of the conquest of cosmic space, of interplanetary communications, and the creation of artificial earth satellites and planets.

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The resolutions of the Twenty-First Congress of the CPSU which approved the program for building communism call upon every Soviet person, no matter who he may be -- worker, kolkhoz peasant, or scientist -- for a new outpouring of effort and they generate the noble aspiration to work still better and more persistently for the good of our Motherland. An upheaval of creative construction has seized the entire Soviet people who see in the outlines of the Seven-Year Plan the commands of their own hearts and their own minds.

As N. S. Khrushchev pointed out in his report to the Twenty-First Congress of the CPSU: "...the building of communism presupposes not only a previously unheard of development of economics, science, and culture, but it opens unprecedented vistas for the most complete and comprehensive development and revelation of all the creative possibilities of man." The ideas of the teachings of Marx and Lenin which permit one to see the world in all its complexity, contradictions, and at the same time all its inexhaustible wealth of colors have been recognized as playing an enormous role in the discovery and enrichment of the creative possibilities of man. It makes man daring in his knowledge and his work, confident of his own strength and in his mastery over nature.